

DEMONSTRATION OF A NAVY WEATHER INFORMATION PROCESSOR (NWIP) USING AN/SPY-1 WEATHER DATA

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LONG TERM GOALS

Developing techniques for using Doppler weather radar data in real time involves considerations that range from data quality issues, to current-time weather products, to the assimilation of radar information into forecast models. Traditional developments of algorithms for these tasks often accept the implicit constraining logic that is imposed by the radar scan strategy and related limitations. The advent of phased array weather radar technology provides an opportunity to revisit these constraints, with the expectation of achieving major improvements in data quality and product accuracy. Navy needs for over-sea radar operations may degrade data quality due to sea clutter, surface ducts, and low reflectivity. It is important to understand the practical impact of these factors on the end-products. A companion issue is the use of information from other sensing systems to assess potential degradation of radar data quality.

OBJECTIVES

The principle objective is to demonstrate that the SPY-1 weather radar produces data, which are suitable for use in nowcast applications, such as the NWS NEXRAD algorithms and the FAA's Integrated Terminal Weather System (ITWS) algorithms. Since the existence of surface ducts could degrade data quality to the degree that these products are erroneous and misleading, another objective is to develop a prototype system that uses the presence of GPS anomalies to detect the existence of surface ducts.

APPROACH

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Evaluate weather product generation using SPY-1 weather data: The plan is to convert archived SPY-1 data to a format that is suitable for use in playback mode, using the ITWS product suite. The first products to be evaluated are the ITWS Storm Motion and Extrapolated Storm Position products. A Navy-oriented situation product display will be used, instead of the FAA's ITWS Situation Display. There are three subtasks: (1) data translation, (2) storm product generation and evaluation, and (3) product display.

Develop a GPS-based system that will issue surface duct alerts: The plan is to develop operational prototype PC software that will monitor and control two GPS receivers to search for near-horizon satellites. The ability to lock on a satellite, when it is below the horizon, is an indication of the existence of a surface duct. There are four subtasks: (1) manual demonstration of the concept, (2) software to command the GPS receiver to seek near-horizon satellites, (3) software for real-time determination of near-horizon satellite contacts, and (4) software to determine if there is an indication of the existence of a surface duct. A field test will be needed to establish the skill of this detection system (probability of correct detections and probability of false detections).

WORK COMPLETED

SPY-1 weather products: The software tasks for the reading and translation of the SPY-1 archive data has been developed and tested on a sample archive data tape. The product displays have been developed and tested on reformatted NEXRAD data. The display concept, involving display registration with respect to the ship position and the extrapolation of both the ship and storm positions to a future time, is illustrated in Figure 1. Production of the storm motion products from SPY-1 data has been delayed by the late delivery of an appropriate data set.

GPS detection of surface ducts: Manual analysis by NCCOSC has provided several cases where the surface duct condition has been correctly identified by this technique. Software has been developed to access the GPS receivers and to command their operational mode to seek near-horizon satellites.

RESULTS

Off-line evaluation of the SPY-1 weather radar data indicates that it is likely that these data will be satisfactory for the generation of ITWS products. There has been no opportunity to evaluate real-time data quality.

Manual testing of the GPS technique has provided many cases where the analysis of communication with below-horizon satellites does correlate closely with the existence of surface ducts.

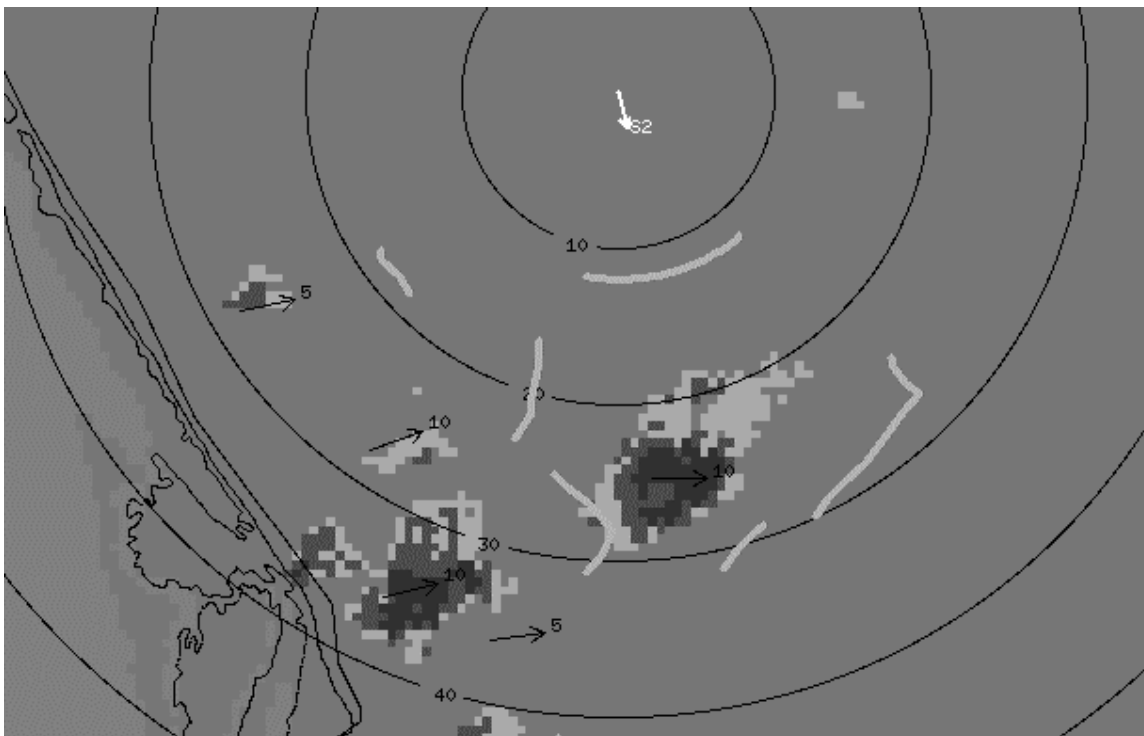


Figure 1. Display of storm locations, storm motion vectors, and the anticipated storm positions in 30 minutes, off the Florida coast. Also indicated are the current ship position, at the center of the 10 n. mile range rings, and the anticipated ship position in 30 minutes.

IMPACT

The FAA ITWS products have been demonstrated to be extremely valuable for enhancing the efficiency of air traffic management in the terminal area. Successful adaptations of these products for the use of SPY-1 weather data would enhance the efficiency of NAVAIR and NAVSEA traffic management.

Surface ducts can significantly degrade SPY-1 performance. The GPS surface duct alert technique could provide a low-cost, passive detection capability, that would enhance the other surface duct detection techniques.

TRANSITIONS

Transition of the ITWS products to battle group use would depend on the operational deployment of the SPY-1 weather capability. These products would be an adjunct to other battle group weather information.

The GPS surface duct alert system would most likely be deployed as a low cost stand-alone system, consisting of 2 GPS receivers, a PC, and a display to provide surface duct alerts to SPY-1 operators.

RELATED PROJECTS

SPY-1 Weather Experiment, Hank Owen, Lockheed Martin, Moorestown NJ (PMS-400 and ONR)

GPS Alert Project, Ken Anderson, NCCOSC RDTE DIV D883 (ONR)

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